THERMAL NEUTRON CAPTURE CROSS SECTIONS OF ^{68}Ge, and ^{148}Gd

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One of the basic properties of a nucleus is its neutron capture cross section. This quantity determines the rate at which a nucleus can be destroyed by neutron exposure. Knowledge of such cross sections is extremely important in calculations of the abundances of nuclei that emerge from astrophysical environments in which free neutrons are present. Techniques now being proposed to transmute long-lived radioisotopes into shorter lived ones also require knowledge of these cross sections. Over the years, thermal neutron capture cross sections have been measured for essentially all of the stable isotopes. There is currently a great deal of interest in nuclear astrophysics and other areas of nuclear physics in cross sections measurements on radioactive nuclei. However, there is very little experimental data on neutron-capture cross sections for radioactive nuclei. During the past year, we have continued our series of measurements of thermal (n,γ) cross sections on long-lived radioisotopes using an activation technique. In the cases we have chosen, the addition of one neutron to the target nucleus produces a short-lived nuclide whose decay can be measured by γ-ray counting. Our result for the ^{44}Ti capture cross ssection of 1.1 $\pm$ 0.2 barns has been published [1]. The next isotopes we studied were ^{68}Ge and ^{148}Gd.

We performed these experiments at the Oregon State University 1-MW TRIGA reactor facility. In each case, a measured quantity of the target of interest was irradiated in a flux of $1x10^{13}$ thermal neutrons/cm^2-sec. The integrated flux that each sample was exposed to was measured by using iron flux monitors. After irradiation, gamma rays from the radioactive decays of each sample were measured using a high-purity Ge detector. Data acquisition was performed using an ORTEC ADCAM PC-based system. Spectra were recorded in appropriate length time bins so as to follow the half-life of the isotope of interest

For the ^{68}Ge(n,γ) experiment, we measured the yield of the characteristic 1106-keV γ-ray produced in the decay of the 39-hour ^{69}Ge activity. Preliminary analysis of the data from this experiment indicates that the thermal neutron capture cross section for ^{68}Ge is 0.94 $\pm$ 0.25 barns. In the case of ^{148}Gd(n,γ) we measured the yields of the characteristic 150-, 299-, and 347-keV γ rays produced in the decay of the 9.3-day ^{149}Gd. Analysis of this data yields a value of 1.4 $\pm$ 0.1 $x10^4$ barns for the thermal neutron capture cross section of ^{148}Gd.

Footnotes and References

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[1] R. Ejnisman *et al.*, Phys. Rev. C **58**, 2531 (1998).